LV-IMLI: Integrated MLI/Aeroshell for Cryogenic Launch Vehicles, Phase I

Completed Technology Project (2011 - 2011)

Project Introduction

Cryogenic propellants have the highest energy density of any rocket fuel, and are used in most NASA and commercial launch vehicles to power their ascent. Cryogenic propellants must be kept cold to preserve them and prevent loss via boil off, therefore cryogenic launch vehicles and spacecraft must have thermal insulation preserving the cryopropellant. Providing good thermal insulation is a balancing act between the insulation desired, the mass of the insulation system, and the robustness of the insulation. SOFI, for example, has high heat leak and is not robust. Quest Product Development Corp, and partner Ball Aerospace, propose to design, fabricate and test innovative Launch Vehicle⬌MLI (LV-MLI), an integrated advanced thermal insulation and lightweight aeroshell for launch vehicle exposed cryopropellant tanks. A ruggedized of Integrated MLI, high performance lightweight thermal insulation, could be bonded to the sidewalls of LOX/LH2 cryotanks in the Atlas V and Delta IV and might be able to withstand aerodynamic loading during launch ascent. LV-MLI has the potential to significantly improve upper stage cryogenic tank thermal insulation, and might increase payload capacity for NASA, national security and commercial missions that require multi-hour coasts such as required for MEO and GEO orbit insertion. LV-MLI should have 34% the mass of the SOFI insulation, while providing about 85 times better thermal insulation. This Phase I research will evaluate Launch Vehicle-MLI aerodynamic and thermal requirements, analyze aerodynamic and acoustic vibration launch loading, design LV-MLI insulation system to withstand those aerodynamic and launch environment loads, design and build a unique launch dynamic load simulator, build and test a LV-MLI prototype for aerodynamic and vibration simulated launch loads, and finally compare the structural and thermal performance of LV-MLI to the requirements and modeled/predicted performance.

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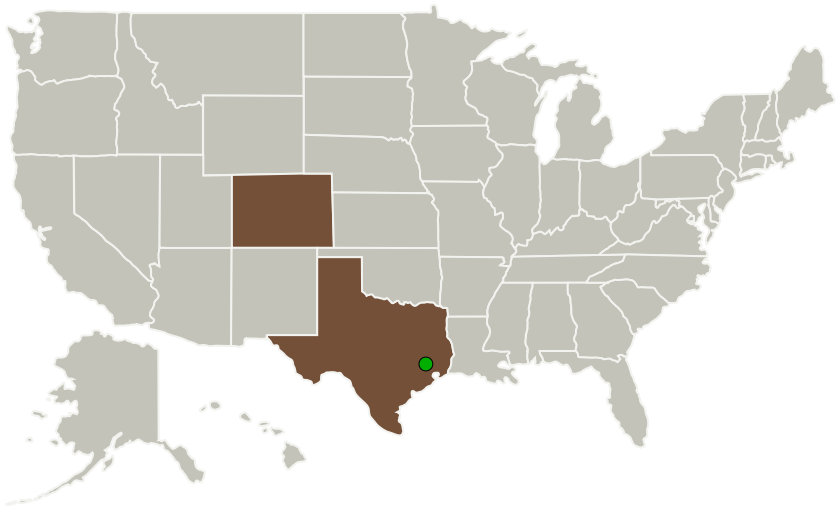
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Quest Thermal Group	Lead Organization	Industry	Arvada, Colorado
Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations	
Colorado	Texas

Project Transitions

February 2011: Project Start

September 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138283)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Quest Thermal Group

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Scott A Dye

Co-Investigator:

Scott Dye

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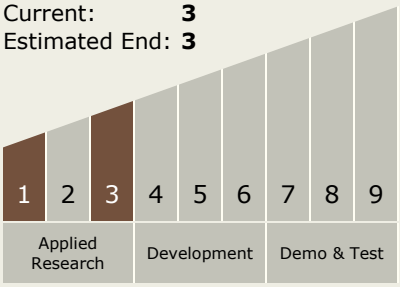
Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.1 Cryogenic Systems
    - TX14.1.2 Launch Vehicle Propellant

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System